

TOP 4 CAUSES OF STORAGE I/O BOTTLENECKS & HOW TO MITIGATE THEM



INTRODUCTION

When storage performance issues are present, it impacts several resources attached to the storage system. Disk capacity, as well as storage I/O performance is critical to many users working in different environments. If users are affected by storage performance, this can affect business profitability and overall performance. Troubleshooting storage issues is a complex matter. It takes time to diagnose application performance issues in your environment and determine if it's due to disk storage. If you're an IT pro and have to deal with storage performance, the best way to approach troubleshooting is by drilling-down layer by layer from the application to the datastore.

Managing storage performance is no small task. Disk space is one those things the typical systems administrator often has little control over. If the number of users accessing a storage system has increased, the volume of data being stored will increase as well. Unfortunately, if it's a straight disk capacity issue then there's nothing you can do because performance is going to take a hit at some point when storage disks are going to run of space.

However, often it's not a disk capacity issue, but a storage I/O bottleneck problem that can occur in a storage environment because of the unbalanced load placed on the storage systems by the application environment. There are various components that affect the performance of storage systems. In this whitepaper, we are going to discuss the top 4 reasons why storage I/O bottlenecks occur and how it impacts the overall storage performance. We will also go over some tips and best practices to achieve optimum performance of your storage system.

Causes of Storage I/O Bottlenecks

1. Virtual Storage

A virtual environment is a complex network of interdependent resources. There are many components – virtual machines (VMs), applications running on a VM, external storage, datastores attached to VM hosts, etc. Having many VMs run on a storage LUN from a single datastore can often lead to bottlenecks at a storage level. In addition, if VMs are going to run I/O intensive applications, it's going to put tremendous pressure on the disk, and other applications associated to that storage are also going to suffer performance issues due to resource contention. Memory ballooning and swapping is another common bottleneck that is associated to disk performance. When a VM runs out of physical memory, it's going to page to disk. This is going to lead to more IOPS to the storage system. If your VMs have only a specific storage space, and if multiple users are trying to squeeze through to fit their data, storage I/O is going to be affected because it may not be able to accommodate all user requests.

A bottleneck in storage performance can affect the overall system performance. Storage issues create slowdowns to your VMs, guest operating systems, and to applications running in your VMs. Storage I/O issues can cause your VMs to experience storage timeouts and it can go to the extent of causing your VMs to freeze and even crash.

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2. Application Bottlenecks

Applications that are I/O heavy often cause bottlenecks. As well as often causing the problem, I/O intensive applications are often more sensitive to a storage latency issue. When you have a large user base trying to access these applications, slowdowns tend to take place. Under such circumstances, IT pros should start troubleshooting from the server layer all the way down to the storage drives. You can never easily tell it's a storage issue right away when you see a problem. It's best to diagnose through each level so you know if it's really a storage issue or an application or virtualization bottleneck.

If it's not an application issue, but a storage issue, it could be caused due to lack of storage drives to service the I/O. It can also be due to issues occurring because of lack of bandwidth at the array's front-end ports or it can be due to an issue with the controller. The best thing you can do to solve application bottlenecks is trying to find a balance between your most frequently used applications:

- » Applications that are used by a large user base
- » Applications that are not so storage I/O bandwidth heavy

Having a clear distinction helps you tune performance levels for either having a great storage throughput or for optimizing IOPS. Another tip to keep in mind is application bottlenecks can occur if you have multiple busy applications using the same datastore. Neither application is going to have optimum performance causing storage and application bottlenecks.

3. I/O Response Time

Increased response time in storage I/O causes bottlenecks. When there is a queue in the storage I/O, you would generally see an increase in latency. If the storage drive is taking time to respond to I/O request, then this indicates there is a bottleneck in the storage layer. A busy storage device can also be the reason why the response time is higher. As you keep adding more workload with existing I/O bottlenecks, the response time will also vary.

You can add more disk volumes to improve the performance. But before you do so, it's critical to monitor your networks, servers, and applications before pointing out issues to your storage system.

4. Poor Storage Design

The Fundamental reason why storage bottlenecks arise is because of a poorly designed storage system. It's very evident when the storage system can't process the amount of work that a user is trying to run, ultimately causing all kinds of bottlenecks and I/O performance issues. The most common design flaws include:

- » Fewer spindles in a RAID group trying to take on the entire workload
- » Having to use under-performing SATA drives with low RPMs
- » Not load balancing storage drives and processors
- » Using a RAID level that has a high write penalty
- » Using smaller array cache

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Having any one of these issues is going to affect storage performance. Therefore, it's important to understand how your physical storage along with the underlying LUNs, RAID groups, and disks are aligned to each other so it helps eliminate any performance bottlenecks.

Best Practices to Avoid Storage I/O Bottlenecks

I/O bottlenecks are common issues that impact the performance of your storage system. You have to dig down to discover what it is that's troubling your storage systems. Instead of being reactive under such situations, here is a list of tips and best practices you can proactively follow to avoid storage I/O bottlenecks.

1. Map drive types against performance. You need to consider the virtual environment where the storage component can change the alignment quickly. If you have critical applications and don't want them to fail or cause storage issues, then have better performing storage drives assigned to critical applications. You must also ensure that no two critical applications are assigned to a single disk. It's also a good idea to make sure you have anti-colocation policies for critical I/O heavy applications.

2. Change RAID type to match workload. Once you change your RAID type to match your application workload, you are going to see faster application performance. You will also see application availability improvements since the RAID controller can recreate lost data from parity information. For example, if you're after performance, then RAID 10 will work well; if you have bandwidth intensive applications, you can use RAID 1, etc.

3. Upgrade to larger cache. Having a large cache means the disk is going to have improved read and write operations and lesser performance I/O bottlenecks. Placing solid state drives in front of disks can act like a large cache and significantly increase IOPS capacity.

4. Allocate storage based on performance. Understand what are your critical processes and applications that cannot have downtime. Based on this allocate storage so you have enough drives for the throughput and IOPS.

Proactively Monitor Storage I/O Bottlenecks

If you really need assistance with managing your storage systems, then you should consider having end-to-end storage monitoring. In case you decide to deploy storage performance monitoring tools, you should consider monitoring the following:

- » 1. IOPS – you can look at overall IOPS, read/write for I/O
- » 2. Storage throughput
- » 3. Storage latency at the device, storage pool and LUN level

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